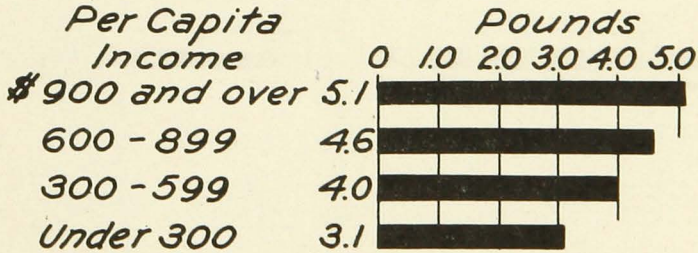
Bulletin 311 October 1934

UNIVERSITY OF MINNESOTA
AGRICULTURAL EXPERIMENT STATION

A STUDY OF THE CONSUMPTION OF DAIRY PRODUCTS IN MINNEAPOLIS, 1934

WARREN C. WAITE
REX W. COX
DIVISION OF AGRICULTURAL ECONOMICS



Monthly Per Capita Consumption of Butterfat in all Dairy Products at Various Income Levels

UNIVERSITY FARM, ST. PAUL

A STUDY OF THE CONSUMPTION OF DAIRY PRODUCTS IN MINNEAPOLIS, 1934[1]

WARREN C. WAITE
REX W. COX

INTRODUCTION

The purpose of this study is to show the variations in the rates of consumption of the different dairy products by families in Minneapolis and to account for the differences in these rates. The study is based on the reported consumption of groups of families in various parts of the city, the families having been selected in such a way that they are thought to give a good representation of conditions in the city as a whole. From January 15 to February 12, 1934, enumerators called upon all families who were at home in 228 selected areas. These areas were distributed fairly evenly over the residential part of the city at distances of four or eight blocks, as is shown in Figure 1. It is thought that this method of sampling is most effective in disclosing homogeneous consumption areas in the city. Moreover, the selection of families from so many scattered areas is almost certain to result in the inclusion of families with all the important differences in characteristics responsible for variations in the consumption of these products. The replies given by the housewives to the questions asked relative to the use of dairy products and the characteristics of the families constitute the data of the study. Information was obtained from 2,187 families, which included 8,783 persons.

This bulletin first describes the variations found in the rates of consumption of the different dairy products included. Next, it outlines the sections of the city having similar rates of consumption and considers some phases of competition as related to these areas. It then presents an analysis of the factors influencing rates of per capita consumption in the various families and considers certain phases of competition between products.

VARIATIONS IN RATES OF CONSUMPTION

The average rates of consumption found in the study and the proportion of families using the different products are given in Table 1.

Nearly all families reported the use of butter and fluid milk, about three-fourths reported the use of cheese, about one-half reported the use

[1] This study was made possible through a grant of CWA funds, Project No. 3817. The survey and tabulations were made by Walter Garver, O. J. Thorstad, Clarence Caparoon, Ruben Smith, George Mountford, Norman Brandhorst, and Clayton Lien. We wish also to acknowledge the suggestions of Prof. W. B. Combs of the Division of Dairy Husbandry, University of Minnesota.

of light cream and ice cream, and about one-fourth of the families used heavy cream and evaporated milk.

Table 1

All Dairy Products: Proportion of Families Using Them, and Family and Per Capita Consumption in Minneapolis, 1934

Product	Proportion of families using product, per cent	Average consumption for all families	
		Per family	Per person
Milk, pints per day	96.4	3.40	0.85
Light cream, half-pints per week	56.8	2.06	0.51
Heavy cream, half-pints per week	21.7	0.58	0.14
Butter, pounds per week	98.9	2.61	0.65
Cheese, pounds per month	72.4	1.98	0.49
Evaporated and condensed milk, pounds per month	29.8	2.84	0.71
Ice cream, quarts per month	50.2	1.16	0.29

The rates of consumption found in this survey are high in relation to the rates reported in many surveys of a similar type in other cities.[2] The results of a few of the more important surveys are given in Table 2. It should be noted that the rates in the Minneapolis survey are actually higher than those reported elsewhere and that the Minneapolis survey was made during a period of depression, whereas the surveys in the other cities were made during periods of relative prosperity.

Table 2

All Dairy Products: Comparison of Rates of Per Capita Consumption in Various Surveys

Product	New Jersey* 1929 (Native whites only)	Boston† 1930	Philadelphia‡ 1929	Minneapolis 1934
Milk, pints per day	0.77	0.78	0.71	0.85
Light cream equivalent, half-pints per week	0.64	0.52	0.36	0.72
Butter, pounds per week	0.71	0.62	0.42	0.65
Cheese, pounds per month	0.48	...	0.44	0.49
Evaporated and condensed milk, pounds per month	0.42	0.56	0.36	0.71
Ice cream, quarts per month	...	...	0.86	0.29

* C. B. Howe and W. C. Waite, The Consumption of Dairy Products in Seven Metropolitan Cities of New Jersey. N. J. Agric. Expt. Sta. Mimeo. 1932.

† F. V. Waugh, Consumption of Milk and Dairy Products in Metropolitan Boston. New England Research Council on Marketing and Food Supply. Boston. 1931.

‡ F. F. Lininger and H. Metzger, The Consumption of Dairy Products by 1,370 Families in Philadelphia. Bulletin 245, Pennsylvania State College. 1930.

[2] There is a tendency for a survey of this character to result in high rates of consumption due to a bias in the reports by consumers. In the case of fluid milk, this usually amounts to about 15 per cent. The bias, if any, in the case of other products is unknown. Since there is no reason to assume the bias is different in any part of the data, the relationships developed in the analysis are unaffected by it.

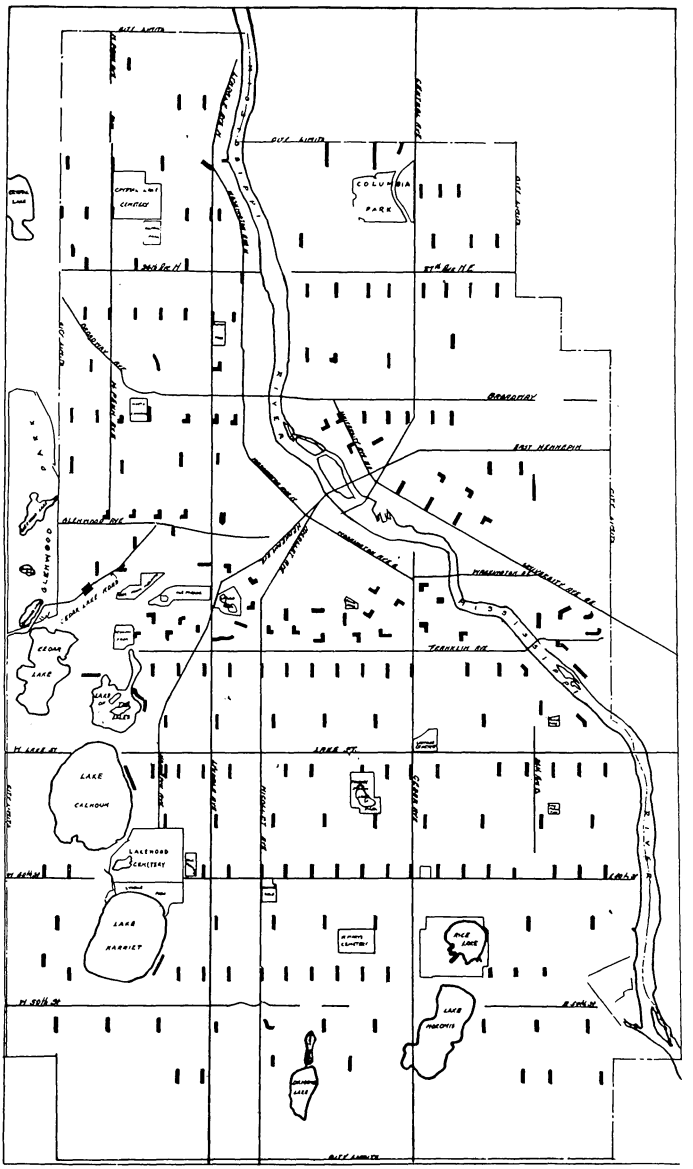


Fig. 1. Location of Areas Surveyed, Minneapolis, 1934
These areas are distributed fairly evenly over the city at distances of four to eight blocks.

The average rates of consumption for the city as a whole were derived from families showing a wide range in per capita consumption. The most usual rate of consumption for fluid milk was about one pint daily for each person, with 73 per cent of the persons reported in families consuming at per capita rates between 0.40 pints and 1.19 pints daily. The National Dairy Council has recommended a daily milk consumption of one quart for each child and one pint for each adult in families on relief. Less than 33 per cent of the families in the survey, excluding relief families, are consuming at rates sufficiently high to meet this standard. When families without children are excluded, only 19 per cent of the families meet this standard. Table 3 shows the percentage of families reporting consumption at less than specified rates per capita. This table indicates that the families consuming at low rates include a greater proportion of all adults than of all children. For example, 48 per cent of the adults are in families with a per capita consumption of less than 0.80 pints daily, whereas only 41 per cent of the children are in these families.

Table 3

Milk: Cumulative Distribution of Families, of Adults, and of Children, According to the Per Capita Rates of Consumption

Rates of consumption, pints per day	Proportion of total			
	Families	Adults	Children	All persons
	per cent	per cent	per cent	per cent
Less than 0.20	4.7	4.6	2.1	3.8
0.40	10.1	10.9	6.2	9.4
0.60	26.1	29.2	22.5	26.9
0.80	43.7	48.0	40.8	45.6
1.00	52.0	58.0	55.7	57.3
1.20	79.7	82.4	81.0	81.9
1.40	89.9	91.8	91.8	91.8
1.60	93.1	94.6	95.8	95.0
3.20	100.0	100.0	100.0	100.0

The most common rate of consumption of butter was between 0.50 and 0.74 pounds a week for one person, altho a large group was found consuming about a pound a week. Rates of consumption less than 0.50 pounds a week per capita were not frequent. For example, only 12 per cent of the families consumed at rates of less than 0.40 pounds a person a week and less than 6 per cent at rates of 1.20 pounds or more. Table 4 shows the proportion of the families, and the adults and children found in these families, consuming at less than specified rates. Examination of the table shows that the families consuming at low rates contain a larger proportion of the children than adults. For example, 54 per cent of the children are in families consuming at rates below 0.60 pound a person weekly, but only 41 per cent of the adults.

Table 4

Butter: Cumulative Distribution of Families, of Adults, and of Children, According to the Per Capita Rates of Consumption

Rates of consumption, pounds per week	Proportion of total			
	Families	Adults	Children	All persons
	per cent	per cent	per cent	per cent
Less than 0.20	1.8	2.0	3.1	2.3
0.40	12.1	13.3	20.7	15.5
0.60	39.2	41.0	54.3	44.8
0.80	68.7	70.6	82.6	74.1
1.00	75.6	78.7	91.0	82.4
1.20	94.1	95.0	98.2	95.8
2.00	100.0	100.0	100.0	100.0

Thirty-five per cent of the people are in families that did not report the purchase of cream. The most usual rate of consumption of cream in terms of cream equivalent[3] was between 0.25 and 0.49 pints a person weekly, 21 per cent of the people using cream consuming at these rates. Table 5 shows the proportion of adults, children, and families consuming at less than specified rates. There is a larger proportion of the children than of the adults in the families consuming no cream or consuming cream at low rates. For example, 82 per cent of the children and 67 per cent of the adults are in families consuming less than 1.00 pint a person weekly.

Table 5

Cream: Cumulative Distribution of Families, of Adults, and of Children, According to the Per Capita Rates of Consumption

Rates of consumption, half-pints per week	Proportion of total			
	Families	Adults	Children	All persons
	per cent	per cent	per cent	per cent
Less than 0.50	50.3	51.9	68.6	56.4
1.00	65.7	67.4	82.3	71.2
1.50	77.9	79.8	90.0	82.3
2.00	84.5	86.0	94.0	87.9
2.50	90.5	91.8	96.7	93.0
3.00	92.7	93.9	98.1	94.9
4.00	100.0	100.0	100.0	100.0

The families reporting no consumption of fluid milk contained 3.5 per cent of the adults and only 1.6 per cent of the children, whereas the families consuming no butter contained 1.9 per cent of the adults and 1.1 per cent of the children, and the families purchasing no cream contained 33 per cent of the adults and 43 per cent of the children.

[3] Cream equivalent has been computed by multiplying heavy cream consumption by 1½ and adding this derived volume to light cream consumption.

CONSUMPTION IN DIFFERENT PARTS OF THE CITY

In a city as large as Minneapolis, one may expect to find the average rate of consumption of dairy products differing in various parts of the city. Metropolitan areas generally show a segregation of the population with respect to family composition and income. Usually the areas lying close to the business districts show a larger proportion of males than females and low incomes. The outlying residential sections show a larger proportion of females than males and a high proportion of children, with certain of these sections showing relatively high incomes. There are also a few inlying congested residential sections of very low incomes and a large proportion of children. Examination of the census data shows Minneapolis to have similar characteristics.

Examination by the analysis of variance shows that there are real differences in the average rates of consumption in the 228 areas included in the survey and that they are in general too great to have arisen from discrepancies in the interviews with the families.[4] Further examination shows that the averages in the neighboring areas are nearly the same and that the rate of consumption in the city falls into a number of fairly well-defined sections. A knowledge of these sections may prove useful in the analysis of certain problems in public health, marketing, and education. For example, rates of milk consumption may be one of the factors related to the incidence of certain children's diseases. Information concerning consumption areas, together with a knowledge of the occupations and incomes in these areas, will assist in judging the relative changes in demand for the various dairy products, following a business revival. It may also indicate sections where education in the value of dairy products may be stressed advantageously.

Most of the area of the city lay in sections consuming between 0.70 of a pint and 0.99 pint of fluid milk daily per capita. The areas consuming at rates less than 0.70 of a pint daily per capita lay north of East Hennepin and Glenwood avenues, chiefly in northeast Minneapolis, and along the river. The areas using more than 1.00 pint daily per capita naturally are located in the better residential sections, chiefly around Lake of the Isles, Lake Calhoun, and Lake Harriet, and along East River Road. The location of these areas is shown in Figure 2. It should be noted that these are per capita rates and that the total sales in a particular section will also depend upon the density of population.

The largest area of the city was found consuming butter at rates between 0.50 and 0.79 of a pound a person weekly. The areas consuming

[4] The ratio of the greater to the smaller mean square in the case of milk is 4.15 and for butter 8.28. These ratios lie considerably outside of Fisher's highly significant values for this number of observations and indicate that there is a much smaller chance than one in a hundred that there are not real differences among the areas.

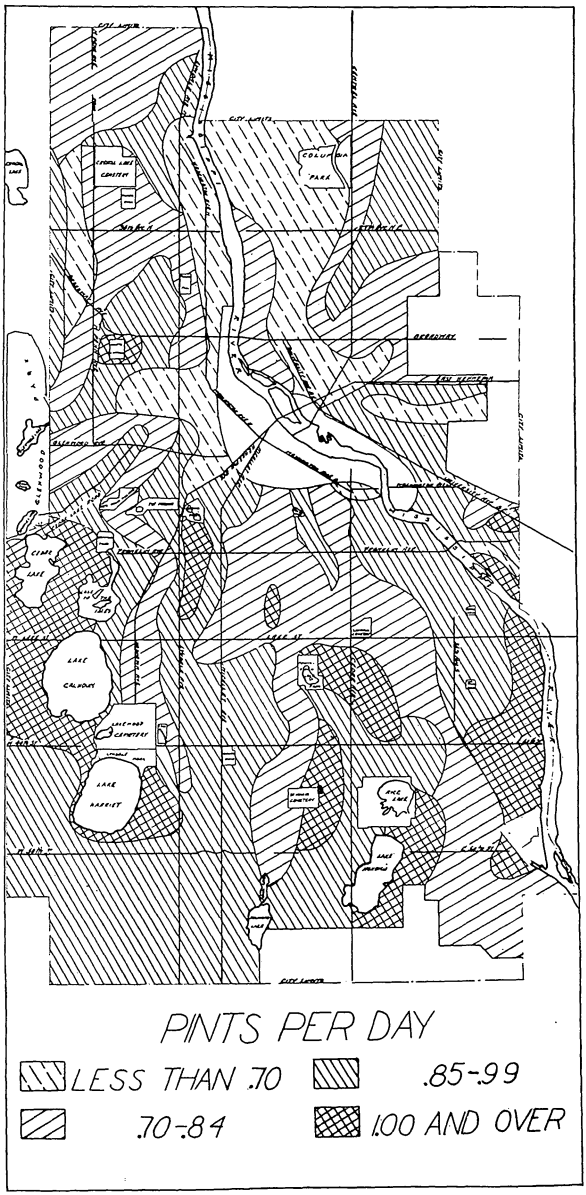


Fig. 2. Milk: Daily Per Capita Consumption, Minneapolis, 1934

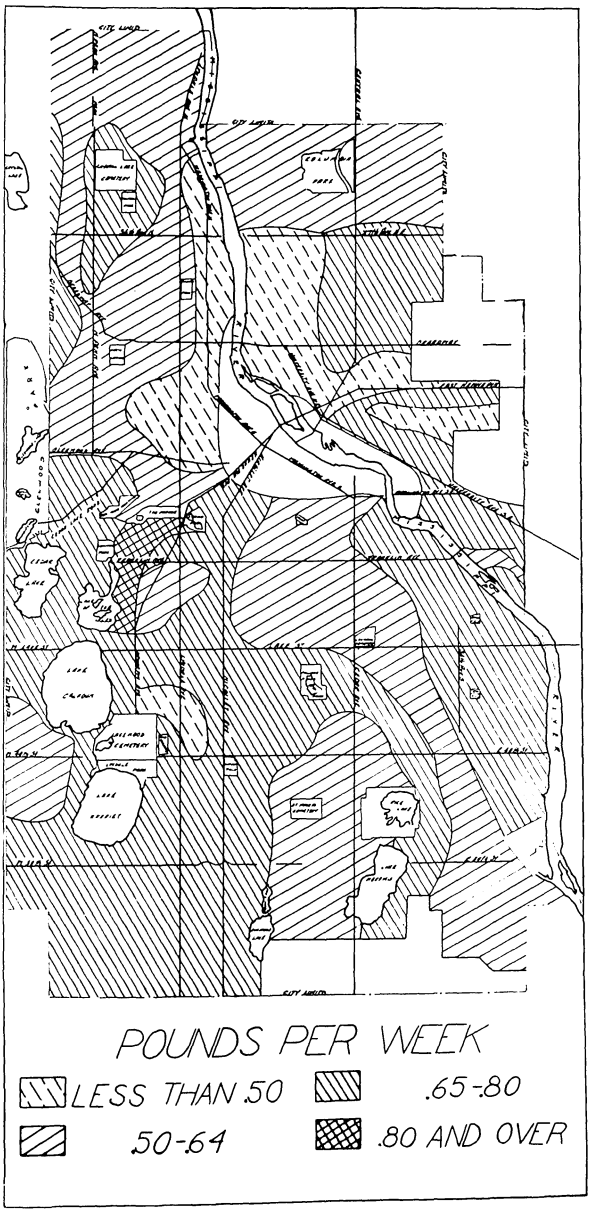


Fig. 3. Butter: Weekly Per Capita Consumption, Minneapolis, 1934

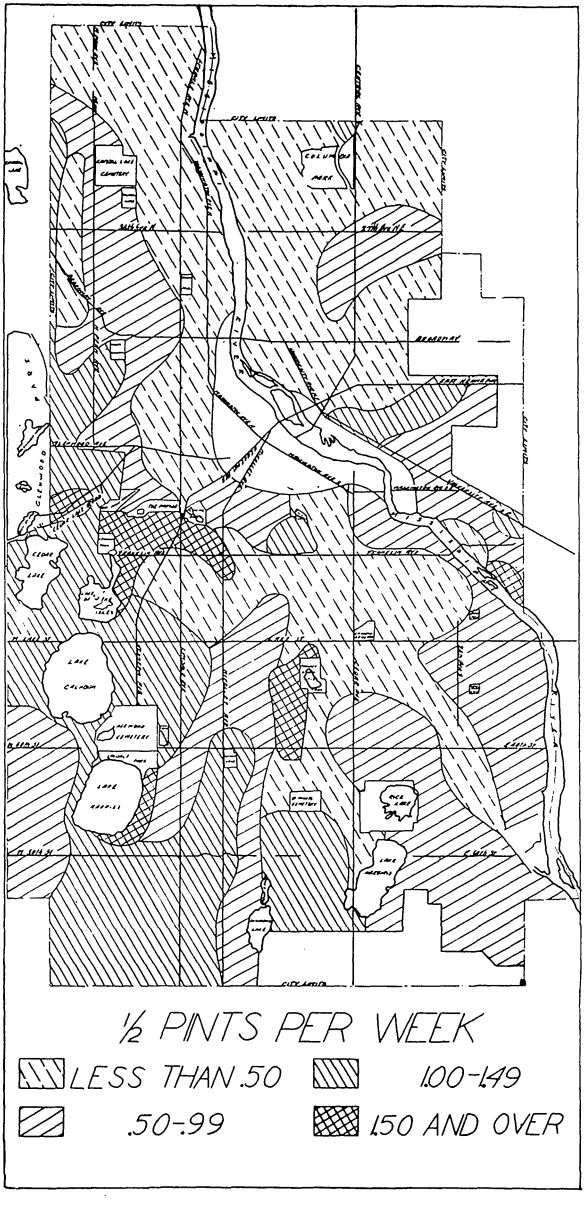


Fig. 4. Cream: Weekly Per Capita Consumption, Minneapolis, 1934

at rates of less than 0.50 of a pound a person are quite similar to the areas of low milk consumption, lying north of East Hennepin and Glenwood avenues, chiefly along the Mississippi River. The area of highest consumption of butter lay north and south of Franklin Avenue in the Lake of the Isles district and around Mount Curve Avenue. These areas are shown in Figure 3.

The greater part of the city reported a weekly cream consumption of less than 0.50 of a pint per capita. The area north of East Hennepin and about half the area toward the river north of Glenwood Avenue and the section through the central part of South Minneapolis, chiefly between Franklin Avenue and Lake Street, show this rate of consumption. The areas of highest consumption were again the Lake of the Isles and Mount Curve districts, with secondary areas around Lake Harriet, Lake Calhoun, and East River Road (Fig. 4).

COMPETITION AMONG SALES OUTLETS

It has been possible in the case of fluid milk and butter to make some study of the competition among outlets, and since this is closely associated with area, a discussion of the results is included at this point. Fluid milk and butter offer an interesting contrast in methods of distribution, fluid milk being almost exclusively of uniform grade and sold at a uniform price throughout the city, while butter is sold at many prices in different outlets and in a range of qualities. The data relative to fluid milk are drawn from the consumers' survey, but the data for butter were obtained from a special survey made of 600 retail stores in various parts of the city.

In these stores, 84 brands of butter were reported sold. Butter was found selling at a range of as much as 10 cents a pound in different parts of the city on the same day. This was due to differences in the quality of the butter and in the type of retail store, depending on the services provided customers, competition from neighboring stores, and volume of business. The 10 brands that had the largest volume of sales showed ranges of 5 cents or more between stores for the same brand on the same day.

The total sales of butter by score and price for the brands that could be scored[5] are given in Table 6. The table shows a striking lack of correspondence between the scores of butter and the price at which it was sold. For example, 90-score butter sold at prices ranging from 24 cents to 32 cents and 93-score butter sold at prices ranging from 27 to 35 cents.

[5] The scoring was made from the brand names by a federal butter inspector. The score of butter designates its grade according to specifications of the United States Department of Agriculture. Butter scoring 93 is of unusually high quality, while butter scoring 87 or 88 is of low quality.

For the butter scoring between 88 and 92, the average price for the individual scores varied by about one-half cent, with 91-score showing the highest and 92-score the lowest price. The reason for the lower average price of 92-score butter was the sale of 3,780 pounds at 26 cents by one of the large local branch stores of the city. If this store is omitted, the average price of 92-score butter is 28.2 cents. Butter scoring 93 averaged about 3 cents higher than the other scores. It is evident that the scores of butter have very little influence upon the price at which it is sold. This lack of relationship is further illustrated by the data in Table 7 which shows the number of stores reporting sales of butter by score and price.

Table 6

Number of Pounds of Butter Selling at Various Prices and Scores in Selected Stores in Minneapolis, 1934

Price per pound, cents	Score of butter						
	Total: All scores	88	89	90	91	92	93
Total: All prices	74,498	3,375	5,024	36,180	13,334	8,573	8,012
24	132	7	....	125	....	....	....
25	4,257	670	175	2,237	375	800	....
26	15,377	401	960	7,852	2,384	3,780	....
27	12,226	573	2,036	7,715	1,068	769	65
28	17,023	995	1,211	7,291	6,057	799	670
29	15,001	563	527	8,222	2,764	1,581	1,344
30	5,197	122	115	2,234	671	540	1,515
31	3,013	4	....	342	15	212	2,440
32	2,102	40	....	162	....	92	1,808
33	15	....	....	....	....	....	15
34	95	....	....	....	....	....	95
35	60	....	....	....	....	....	60
Average price	27.8	27.7	27.3	27.6	27.8	27.2	30.5

Table 7

Number of Times Butter was Reported Selling at Various Prices and Scores in Selected Stores in Minneapolis, 1934

Price per pound, cents	Score of butter						
	Total: All scores	88	89	90	91	92	93
Total: All prices	1,129	67	67	362	209	155	269
24	2	1	..	1	...	...	...
25	24	7	3	10	1	3	...
26	79	7	9	42	14	7	...
27	127	15	20	53	18	18	3
28	242	20	18	102	65	26	11
29	279	11	11	92	77	49	39
30	189	4	6	54	33	32	60
31	105	1	..	5	1	13	85
32	77	1	..	3	..	7	66
33	2	..	..	..	..	..	2
34	2	..	..	..	..	..	2
35	1	..	..	..	..	..	1

The character of the competition in the individual areas is indicated in Figures 5 and 6, which show the location of the stores, the type of store, and the volume, grade, and price of the butter sold. A wide range of volume of sales among stores is indicated, as well as a large variation in the sales of particular brands within a store. Almost without exception, the greatest volume of sales in an individual store was of the lowest-priced butter. Some of the differences in price may be explained by differences in the quality of butter and differences in services provided by the various stores. In stores of the same type, however, a large variation existed in the price of butter of the same quality. In Figure 5, the effect of competition is shown by the uniformity of price among the stores in the upper and lower groups and by the one-cent difference in price of the bulk of sales of butter in the upper and lower groups of stores. There is a range of 4 points in the scores of butter sold at the same price in stores of the upper group and a range of 2 points in the stores of the lower group. Note the three small unit stores lying between those areas of heavy competition. The two stores immediately across the street from one another sold at the same price butter varying 2 points in score, while the two stores on the same side of the street, but approximately two blocks apart, sold the same brand of butter at 2 cents difference in price. The two large local branch stores in the center of the area sold identical brands at a one-cent difference in price, but the one with the higher price was a credit delivery store, whereas the other was a cash-carry store.

The stores at the top of Figure 6 are in one of the most highly competitive areas in the city. In a national chain store, roll butter of a higher score was sold at 2 cents less than print butter in the locally-owned chain store and the unit store in the same block. Higher-scoring print butter in the national chain was sold at the same price as lower-scoring print butter in these two competing stores. As one moved south out of this district, prices were in general a cent or so higher for similar grades.

The most significant result of this study is the wide range shown in the price of similar grades of butter and the indication of the inability of consumers to distinguish differences between brands. The situation revealed in the areas studied is typical of that existing in other areas of the city.

Three or four of the largest milk companies distribute the greater portion of the milk in Minneapolis. There are, however, a large number of small distributors and peddlers operating independent routes. All told, the consumers reported purchasing milk from 54 different companies or delivery agents. The routes of these agencies overlap so that the consumer has a wide choice. This gives more assurance that a

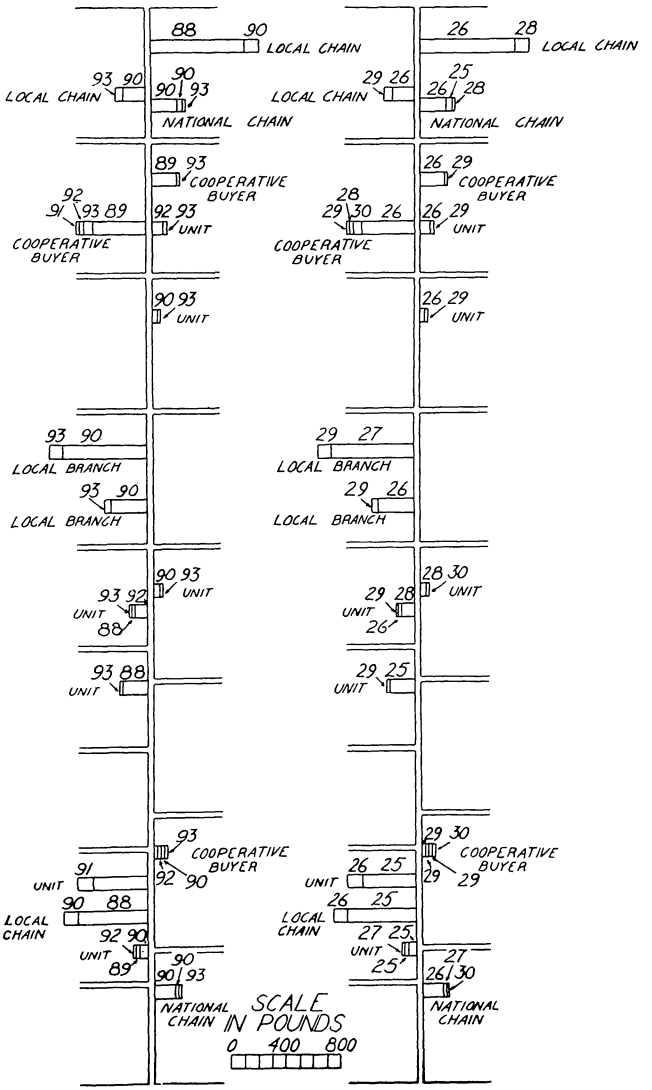


Fig. 5. Type of Grocery Store: Volume, Scores, and Prices of Butter Sold

The group of stores shown in duplicate form in this diagram are in north Minneapolis. The type of the individual store is designated by name. The total volume of butter sold weekly by each store is indicated by the length of the block representing the store, and the volume of each brand by the divisions within the block. The figures on the left part of the diagram represent the score or grade of the particular brand sold, and those on the right represent the price at which this brand was sold. For example, the weekly sales of the local chain store shown near the bottom of the diagram average 480 pounds of a certain brand scoring 88, and 120 pounds of a certain brand scoring 90, or a total of 600 pounds. The corresponding prices at which these brands sold during the period when the data were obtained were 25 cents for the brand scoring 88 and 26 cents for that scoring 90.

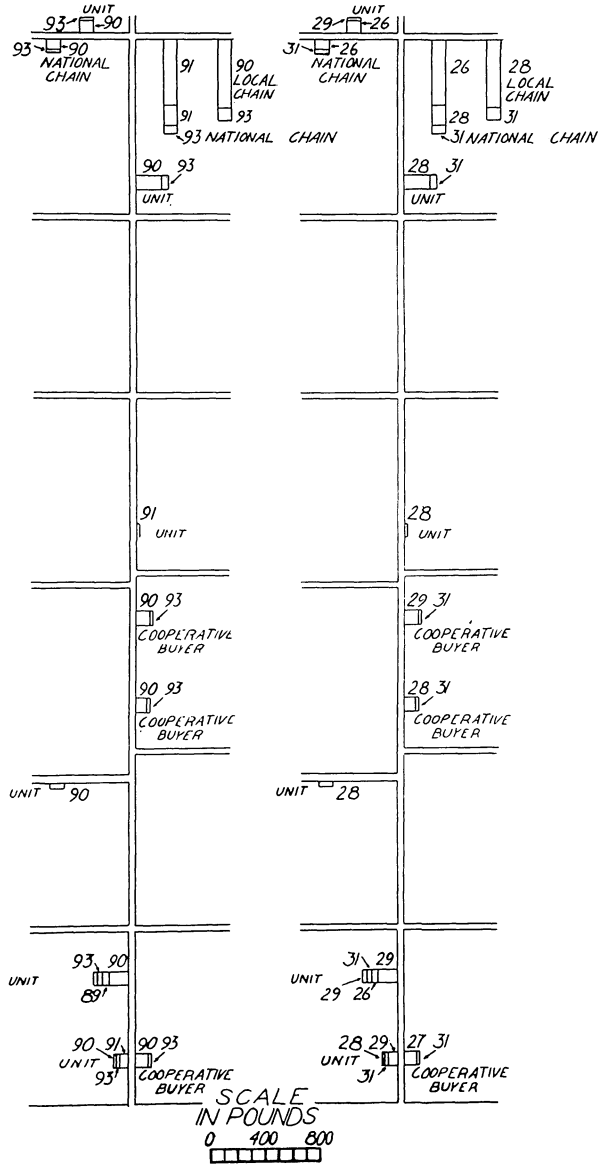


Fig. 6. Type of Grocery Store: Volume, Scores, and Prices of Butter Sold

The group of stores shown in duplicate form in this diagram are in south Minneapolis. The type of the individual store is designated by name. The total volume of butter sold weekly by each store is indicated by the length of the block representing the store, and the volume of each brand by the divisions within the block. The figures on the left part of the diagram represent the score or grade of the particular brand sold, and those on the right represent the price at which the brand was sold. For example, the weekly sales of the co-operative buyer store shown at the bottom of the diagram average 100 pounds of a certain brand scoring 90, and 15 pounds of a certain brand scoring 93, or a total of 115 pounds. The corresponding prices at which these brands sold during the period when the data were obtained were 27 cents for the brand scoring 88 and 31 cents for the brand scoring 93.

company must offer a high quality of service to retain its patronage. In the 34 blocks in which records were obtained from 10 or more families purchasing from distributors, 26 blocks were served by 5 or more distributors, 3 of these being served by as many as 8. Such situations raised the question as to whether duplication of services may not increase costs of milk distribution. In 162 of the 228 areas surveyed, purchases of milk were made at stores as well as from distributors. The proportion of milk purchased at stores was greatest in the apartment house districts and in 10 areas constituted more than 70 per cent of the total.

FACTORS INFLUENCING PER CAPITA RATES OF CONSUMPTION IN DIFFERENT FAMILIES

This section presents an analysis of the factors responsible for variations among families in the per capita rate of consumption of the various dairy products.

The number of children in the family is the dominant factor in determining the rate of milk consumption, with income less important than in the case of other dairy products. Butter is consumed by nearly all families, and the rate of consumption is largely determined by the per capita income of the family, with a large proportion of children a minor factor and tending to decrease the rate of consumption. Cream is purchased almost exclusively by families in the higher-income groups, with per capita income the most important factor in determining the rate of consumption. Condensed and evaporated milk are used largely as a substitute for fluid milk and cream, and per capita consumption is largest in the low-income groups. Cheese is consumed at more nearly uniform rates in all groups than the other manufactured dairy products, altho there is a higher rate of consumption in the high-income groups. The consumption of ice cream varies largely with income. No analysis has been made of the differences among nationalities, since the population is predominantly of north European stock and previous studies have shown that rates of consumption among such groups do not vary greatly.[6]

Milk

There is a significant difference in the use of milk by groups consuming at high per capita rates and those consuming at low per capita rates. Table 8 shows that families consuming at high per capita rates used slightly more milk per capita for purposes other than drinking and a much larger quantity for drinking than families consuming at low per capita rates. For example, in families consuming at rates between

[6] For example see: C. B. Howe and W. C. Waite, ibid., p. 14.
F. V. Waugh, ibid, p. 6.
F. F. Lininger and H. Metzger, ibid., p. 7.

0.40 and 0.79 pints per capita daily, 52 per cent of the milk was drunk, whereas in the families consuming at rates between 1.20 and 1.59 pints per capita daily, 64 per cent of the milk was drunk. Milk drinking is evidently a factor of great importance in high rates of consumption. This conclusion is fortified further by analysis of the data, using the proportion of milk used for drinking and the relationship of milk consumption to the income of the family as the basis of classification.

Table 8

Milk Drinking at Various Levels of Milk Consumption, Minneapolis, 1934

Rate of milk consumption in pints per capita daily	Amount of milk consumed per capita			Proportion used for drinking
	Total	Drunk	Other uses	
	pints daily	pints daily	pints daily	per cent
0.01-0.39	0.27	0.08	0.19	29.6
0.40-0.79	0.59	0.31	0.28	52.5
0.80-1.19	0.95	0.56	0.39	58.9
1.20-1.59	1.33	0.85	0.48	63.9
1.60-1.99	1.65	1.06	0.59	64.2

Income does not have as great an influence upon milk consumption as it does upon the other dairy products. Table 9 shows that on all income levels nearly all families reported the purchase of fluid milk. The per capita consumption of 0.77 pints daily in the lowest-income classification is much less than in any other group. Moreover, the per capita consumption does not vary greatly among the higher-income groups. The slight decline in the highest-income group probably is due to the greater cream consumption in that group.

Table 9

Milk: Per Capita Consumption at Various Income Levels, Minneapolis, 1934

Per capita income	Proportion of families using milk	Per capita consumption*
	per cent	pints daily
Under $300	96.5	0.77
$300-$599	97.7	0.93
600- 899	95.5	1.00
900 and above	97.1	0.97
All families	96.9	0.86

* Examination of these data by the method of variance shows the classification to be highly significant.

The differences in consumption shown in Table 9, particularly those in the lowest-income group, may be explained largely in terms of milk drinking as is shown in Table 10. In the low-income group, people do not drink as much milk, 22 per cent of the adults and 80 per cent of the children drinking milk, as compared with 40 per cent of the adults and 88 per cent of the children in the high-income group. The smaller con-

sumption of milk in the low-income group is largely due to the decrease in the number of adults drinking milk.

Table 10

Influence of Income on the Proportion of Adults and Children Drinking Milk, Minneapolis, 1934

Per capita income	Proportion of adults and children drinking milk	
	Adults	Children
	per cent	per cent
Under $300	21.7	80.3
$300-$599	29.0	90.4
600- 899	34.9	96.3
900 and above	40.3	88.2
All families	27.6	84.4

Presence of children in the family is evidently an important factor in milk consumption, since high rates of milk consumption are associated with high rates of milk drinking and children are the principal milk drinkers. Table 11 shows the average per capita milk consumption in families with per capita incomes below $300 and composed of different numbers of adults and children. It is evident that in families containing a given number of children, an increase in the number of adults in the family causes a decline in milk consumption per capita. On the other hand, in families of a given number of adults there is no such tendency as children are added to the family; on the contrary, there is an opposite tendency, except in the families with the largest number of children, some of whom are old enough to approach adults in characteristics.

Table 11

Milk: Per Capita Consumption in Families of Varying Number of Adults and Children and with Per Capita Incomes below $300, Minneapolis, 1934*

Number of children	Number of adults			
	2	3	4	5
	pints daily	pints daily	pints daily	pints daily
None	0.69	0.74	0.64	0.52
1	0.85	0.76	0.75	0.66
2	0.99	0.81	0.76	0.75
3	0.90	0.75	0.69	...
4	0.86	1.05	...	...
5	0.82	...	...	...

* Averages of groups of less than 10 families have been omitted. The correlations of the data in this table, with X_1 as the average consumption reported, X_2 the number of adults, and X_3 the number of children, are as follows: $R_{1.23} = +.75$, $r_{23} = -.36$, $r_{12.3} = -.31$, $r_{13.2} = +.27$. The regression equation is $X_1 = .885 - .054X_2 + .035X_3$.

Table 12

Milk: Per Capita Consumption in Families of Varying Numbers of Adults and Children and with Per Capita Incomes between $300 and $599, Minneapolis, 1934*

Number of children	Number of adults				
	1	2	3	4	5
	pints daily	pints daily	pints daily	pints daily	pints daily
None	1.09	0.95	0.79	0.72	0.66
1	...	1.05	0.93	0.89	...
2	...	1.04	0.96	0.94	...
3	...	1.09	...	...	...
4	...	...	...	...	...

* The averages of groups of less than 10 families have been omitted. The correlations of the data in this table with X_1 as the average reported, X_2 the number of adults, and X_3 the number of children are as follows: $R_{1.23} = .95$, $r_{23} = -.15$, $r_{12.3} = -.85$, $r_{13.2} = +.66$. The regression equation is $X_1 = 1.138 - .093X_2 + .060X_3$.

These tendencies become clearer in the higher-income groups. Table 12 shows the average per capita milk consumption in families with per capita incomes between $300 and $599, where these families contain varying numbers of adults and children. This table also shows a decreasing per capita consumption as families with a given number of children contain more adults, and a marked tendency toward an increase in consumption in families with a given number of adults as the number of children increases. These same tendencies appear in the higher-income groups. It therefore seems that high rates of milk consumption are occasioned largely by milk drinking. Children are the principal milk drinkers on all income levels, altho in the highest-income levels more than 40 per cent of the adults drink milk. Limitations of income restrict milk consumption by decreasing markedly the number of adults drinking, decreasing slightly the number of children drinking, and lowering the per capita rate of drinking. The proportion of the milk that is drunk, however, increases in the low-income groups. Some increase in milk consumption will probably follow an increase in income, but the change is significant only in the lowest-income ranges. If milk consumption is to be increased, it seems necessary to persuade present drinkers to consume at higher rates or to get a larger proportion of adults to drink milk.

Cream

The situation in the case of cream offers a marked contrast to that of milk. The rate of cream consumption depends largely upon income. In the higher-income groups, about 90 per cent of the families used cream, while in the lowest-income group only about 50 per cent of the families reported the use of cream. The largest number of families on all income levels bought light cream only, but the proportion of families using heavy cream increased rapidly with income (Table 13).

Table 13

Cream: Number and Proportion of Families Reporting the Use of Light and Heavy Cream at Various Income Levels, Minneapolis, 1934

Per capita income	Proportion of families using cream	Proportion of families using light cream only	Proportion of families using heavy cream only	Proportion of families using light and heavy cream
	per cent	per cent	per cent	per cent
Under $300	54.7	40.0	7.8	6.9
$300-$599	75.2	53.3	9.3	12.5
600- 899	90.7	57.5	18.6	14.6
900 and above	89.4	39.0	20.9	29.5
All families	71.1	47.3	11.2	12.6

The influence of income upon cream consumption is also indicated by the changes in per capita rates of consumption in cream-using families (Table 14). Consumption was about three times as great in the high- as in the low-income groups. Families who bought only heavy cream bought nearly as many units per capita as the families purchasing only light cream and in consequence used more cream in terms of butterfat equivalent. The cream equivalent of families using both light and heavy cream was above that of the families using either grade alone.

Adults seem to be the most important consumers of cream. When families in the various income groups are classified in the manner of Table 11, a marked decline in cream consumption takes place as families increase in size because of the addition of children, and a considerably smaller decline takes place as families increase in size because of the addition of adults.

These data indicate that cream consumption may be expected to increase materially following an increase in consumers' incomes and that a further restriction in incomes would decrease consumption. Moreover, the close association of income and consumption indicates that decreases in cream prices would increase consumption considerably.

Table 14

Cream: Per Capita Consumption in Families Using Light Cream Only, Heavy Cream Only, and Both Light and Heavy Cream at Various Income Levels, Minneapolis, 1934

Per capita income	Per capita consumption			
	Families using light cream only	Families using heavy cream only	Families using light and heavy cream	
			Light	Heavy
	half-pints weekly	half-pints weekly	half-pints weekly	half-pints weekly
Under $300	0.64	0.57	0.63	0.24
$300-$599	0.95	0.75	1.26	0.38
600- 899	1.14	1.19	1.64	0.56
900 and above	1.58	1.54	1.52	0.75
All families	0.89	0.91	1.20	0.46

Butter

Nearly all families consume butter. About 98 per cent of the families in the lowest-income group and all families in the high-income group reported its consumption. The amount of butter that is consumed, however, is influenced greatly by the per capita income. As is indicated in Table 15, per capita consumption for all families in the lowest-income group averaged 0.58 pound per week and rose steadily to 0.84 pound in the high-income group.

Table 15

Butter: Per Capita Consumption at Various Income Levels, Minneapolis, 1934

Per capita income	Proportion of families using butter	Per capita consumption*
	per cent	pounds weekly
Under $300	98.2	0.58
$300-$599	99.6	0.71
600- 899	100.0	0.77
900 and above	100.0	0.84
All families	99.2	0.66

* Examination of these data by the analysis of variance shows the classification to be highly significant.

Family composition is also a significant factor in determining the rate of butter consumption within any income class. The number of children in the family influences the rate of butter consumption, but differently from that of milk, the per capita consumption of butter decreasing as the number of children per family increases. These relationships are shown in Tables 16 and 17 and are typical of the other income levels as well. There is also a tendency for a small decline as the number of adults in the family increases.

Table 16

Butter: Per Capita Consumption in Families of Varying Number of Adults and Children and with Per Capita Incomes below $300, Minneapolis, 1934*

Number of children	Number of adults			
	2	3	4	5
	pounds weekly	pounds weekly	pounds weekly	pounds weekly
None	0.77	0.71	0.65	0.71
1	0.61	0.74	0.60	0.66
2	0.67	0.55	0.56	0.53
3	0.54	0.52	0.58	...
4	0.56	0.46	...	...
5	0.46	...	...	...

* Averages of groups of less than 10 families have been omitted. The correlations of the data in this table with X_1 as the average reported, X_2 the number of adults, and X_3 the number of children, are as follows: $R_{1.23} = .88$, $r_{23} = -.36$, $r_{12.3} = -.18$, and $r_{13.2} = -.76$. The regression equation is $X_1 = .776 - .020X_2 - .056X_3$.

Table 17

Butter: Per Capita Consumption in Families of Varying Number of Adults and Children and with Per Capita Incomes between $300 and $599, Minneapolis, 1934*

Number of children	Number of adults				
	1	2	3	4	5
	pounds weekly	pounds weekly	pounds weekly	pounds weekly	pounds weekly
0	0.89	0.89	0.78	0.63	0.69
1	...	0.71	0.77	0.65	...
2	...	0.65	0.69	0.58	...
3	...	0.57	...	...	...
4	...	...	...	...	...
5	...	...	...	...	...

* Averages of groups of less than 10 families have been omitted. The correlations of the data in this table with X_1 as the average reported, X_2 the number of adults, and X_3 the number of children are as follows: $R_{1.23} = .888$, $r_{23} = -.15$, $r_{12.3} = -.617$, $r_{13.2} = -.727$. The regression equation is: $X_1 = .943 - .054X_2 - .077X_3$.

The importance of income as a factor determining the rate of butter consumption indicates that a material increase in its use would depend upon an increase in incomes.

The principal competition with butter is from oleomargarine. Only 11 out of the 2,073 families not on relief reported the exclusive use of margarine, altho 138 families reported the use of both margarine and butter. The families reporting the use of butter exclusively reported a weekly consumption of 0.67 of a pound per capita, while the families consuming both butter and oleomargarine reported a weekly consumption of 0.57 pound of butter and 0.19 pound of margarine. The families consuming only margarine reported a consumption of 0.61 pound per capita weekly. Margarine constituted only 3.3 per cent of the total purchases of butter and margarine reported by the consumers. The survey of grocery stores, however, showed margarine to be 6.9 per cent of the total butter and margarine sales. Most of the margarine was consumed by families in the low-income groups, but averaged only 0.03 pound per capita for all the families in the lowest-income group.

Cheese

Approximately three-fourths of all the families reported the use of cheese, and the variation among income groups was relatively small. Per capita consumption increases with income, rising from 0.41 pound per capita monthly in the low-income group to 0.74 pound in the high-income group. These data are shown in Table 18.

Table 18

Cheese: Per Capita Consumption at Various Income Levels, Minneapolis, 1934

Per capita income	Proportion of families using cheese	Per capita consumption
	per cent	pounds monthly
Under $300	74.7	0.41
$300-$599	73.6	0.54
600- 899	72.1	0.61
900 and above	76.7	0.74
All families	74.2	0.50

Condensed and Evaporated Milk

The situation with respect to condensed and evaporated milk is in marked contrast to that of other dairy products. As indicated by Table 19 the proportion of families using condensed or evaporated milk is highest in the low-income group, with 39 per cent reporting its use, and declines steadily as the income rises, reaching 9 per cent in the highest-income group. The average per capita consumption for all families including both users and non-users declines from 0.84 pound per capita monthly in the low-income group to 0.17 pound in the highest-income group. This decline is occasioned largely by the decrease in the proportion of families using condensed or evaporated milk. In families reporting the use of these products, per capita consumption increases with income in the first three income groups.

Table 19

Condensed and Evaporated Milk: Per Capita Consumption at Various Income Levels, Minneapolis, 1934

Per capita income	Proportion of families using	Per capita consumption	
		In all families	In families reporting use
	per cent	pounds monthly	pounds monthly
Under $300	39.4	0.84	2.13
$300-$599	24.9	0.51	2.33
600- 899	16.6	0.36	2.61
900 and above	9.0	0.17	2.28
All families	27.5	0.62	2.21

It therefore seems that the use of condensed and evaporated milk is governed to a large extent by considerations of economy. An increase in the incomes of consumers would be more likely to decrease than to increase its consumption. A material increase in consumption probably would depend upon low prices of condensed and evaporated milk relative to prices of fluid milk and cream. Evaporated milk serves largely as a substitute for fluid milk. Families, other than relief families, who consumed both fluid and condensed or evaporated milk used a combined

milk equivalent of 0.90 pint of fluid milk per capita daily, while families using only fluid milk reported 0.92 pint per capita daily.

Ice Cream

The data for ice cream are not as reliable as those for the other dairy products, since our data probably include only the bulk purchases and a large quantity is purchased in the form of cones, ice cream sodas, and other occasional dishes. About 50 per cent of the families reported the purchase of ice cream, with a range of 43 per cent in the low-income group to 68 per cent in the high-income group. The per capita consumption increased from 0.17 quart a month in the low-income group to 0.60 quart in the high-income group.

About 20 per cent of the families reported mechanical refrigeration in their homes. Slightly more than half of these families reported that they made ice cream or frozen deserts. However, the purchase of ice cream by families with mechanical refrigeration was greater than the purchase by families without mechanical refrigeration, on all income levels.

RELIEF FAMILIES

In the course of the survey records were obtained from 114 families on relief, and these families have been separately analyzed. The per capita consumption of dairy products in these relief families was less than that found in any of the income groups previously considered, except in the case of evaporated milk, of which the consumption was unusually heavy. The most valid comparison is with the lowest-income group. Fluid milk consumption per capita was about 10 per cent less in the relief families, and evaporated milk consumption was about two and one-half times greater. The milk equivalent was about the same for both groups. Consumption of fluid cream, both light and heavy, and of ice cream was very small. The weekly consumption of butter was about 0.15 of a pound less per capita, and the monthly consumption of cheese was about 0.25 of a pound less per capita.

INFLUENCE OF INCOME ON THE CONSUMPTION OF ALL DAIRY PRODUCTS

The influence of income upon the consumption of the various dairy products holds true for the consumption of dairy products as a whole. In terms of butterfat equivalent, the consumption of dairy products as a whole tends to increase with income (Table 20).[7] In the lowest-

[7] In determining the amount of butterfat consumed, the following percentages were applied to the amount of each product consumed during a period of four weeks: milk, 3.6; butter, 80.0; light cream, 25.0; heavy cream, 37.5; cheese, 35.0; evaporated milk, 7.8, and ice cream, 12.0.

income group, the monthly consumption of butterfat in all products averaged 3.11 pounds per capita and rose steadily to 5.14 pounds in the highest-income group. Butter constituted the principal source of butterfat, amounting to more than 50 per cent of the total on all income levels. Fluid milk was next in importance. The relative importance of the products varied materially among the income levels.

Table 20

Dairy Products: Monthly Per Capita Consumption of Butterfat and Distribution of Products among Families on Different Income Levels, Minneapolis, 1934

Per capita income	Per capita consumption of butterfat	Proportion of total butterfat consumption in					
		Fluid milk	Cream	Butter	Cheese	Evap. milk	Ice cream
	pounds monthly	per cent	per cent	per cent	per cent	per cent	per cent
Under $300	3.11	26.7	6.4	59.3	4.7	2.1	0.8
$300-$599	4.03	25.0	11.4	56.6	4.7	1.0	1.3
600- 899	4.60	23.5	16.1	53.6	4.6	0.6	1.6
900 and above	5.14	20.4	20.4	52.2	5.0	0.3	1.7
All families	3.74	25.0	11.0	56.8	4.7	1.3	1.2

It has been shown that actual consumption of milk increases only slightly with income, butter consumption increases rapidly, and cream consumption increases most rapidly of all. The consumption of cheese remains about the same, and the consumption of evaporated milk declines. When these amounts are converted to butterfat equivalent and expressed as proportions of the total butterfat consumption on that income level, we find that in passing from the low- to the high-income levels butter decreases from 59 to 52 per cent of the total, milk decreases from 27 to 20 per cent, all cream rises from 6.4 to 20.4 per cent, cheese changes slightly, evaporated milk declines from 2.1 to 0.3 per cent, and ice cream increases from 0.8 to 1.7 per cent.

This picture is changed when examined from the viewpoint of expenditures on these products.[8] Per capita expenditures on all dairy products averaged $1.92 a month in the lowest-income group and rose steadily to $3.29 in the highest-income group (Table 21). The largest expenditure was made on fluid milk and ranged from 50.5 per cent of the expenditures on dairy products on the low-income level to 36.8 per cent on the highest-income level. Expenditures on butter declined from 29.5 to 24.8 per cent, whereas total expenditures on cream increased from 9.3 per cent to 27.3 per cent. It is interesting to note that

[8] In determining the expenditure on dairy products, the following costs were applied to the amount of each product consumed during a period of four weeks: milk, 9.0 cents a quart; butter, 24.4 cents a pound; light cream, 12.0 cents a half-pint; heavy cream, 14.0 cents a half-pint; cheese, 21.0 cents a pound; evaporated milk, 7.1 cents a can, and ice cream, 32.0 cents a quart.

while butter was a source of more than twice the amount of butterfat consumed in milk, expenditures on milk exceeded those on butter. Moreover, on the high-income levels, cream expenditures exceeded those on butter and approached expenditures on fluid milk.

Table 21

Dairy Products: Monthly Per Capita Expenditure on Dairy Products and Distribution of Products among Families on Different Income Levels, Minneapolis, 1934

Per capita income	Per capita expenditures on dairy products	Proportion of expenditure on dairy products expended on					
		Milk	Cream	Butter	Cheese	Evap. and cond. milk	Ice cream
	dollars monthly	per cent	per cent	per cent	per cent	per cent	per cent
Under $300	$1.92	50.5	9.3	29.5	4.6	3.2	2.9
$300-$599	2.60	45.2	16.2	26.7	5.9	1.5	4.7
600- 899	3.02	42.3	21.5	25.1	4.4	0.8	5.9
900 and above	3.29	36.8	27.3	24.8	4.7	0.4	6.0
All families	2.37	45.8	15.5	27.4	5.1	1.9	4.3

Table 22

Food Expenditures: Monthly Per Capita Expenditure on Food and Proportion Spent on Dairy Products by Families on Various Income Levels, Minneapolis, 1934

Per capita income	Total per capita expenditures on food	Proportion of food expenditures used for dairy products
	dollars monthly	per cent
Under $300	$ 6.44	29.8
$300-$599	9.40	27.7
600- 899	12.34	24.5
900 and above	15.26	21.6
All families	8.77	27.0

Expenditures on food rise with increases in the per capita income. Expenditures on dairy products also increase but at a less rapid rate, and in consequence the proportion of expenditures on dairy products, in relation to general food expenditures, declines with increases in income. On the low-income level 30 per cent of the food expenditures were for dairy products and on the high-income level, 22 per cent. These data are shown in Table 22.

CONCLUSIONS

Consumption of dairy products in Minneapolis is high in relation to the consumption in eastern cities. This is probably because of its location in the heart of an important dairy region, where the importance of dairy products as an item of food is generally recognized and their retail prices are relatively low. The people are principally of Scandi-

navian origin and such people usually consume a large quantity of dairy products.

The city may be divided into sections within which the rates of consumption are fairly uniform, but there are variations in the total rates of consumption of sections in the different parts of the city. This is a result of the tendency of people with similar incomes and occupations to dwell in the same locality. Because of these differences in occupations and income level, changes in the demand for dairy products following a revival of business activity will probably vary considerably between sections. In general, the lower-income groups spend a larger portion of their total food expenditures on dairy products, altho the per capita expenditure is less than in the high-income groups.

Increases in income may be expected to increase materially the fluid milk and butter consumption in the low-income group; increase butter consumption slightly, cream consumption a great deal, and fluid milk slightly in the medium-income group, and change consumption hardly at all in the higher-income group. The relationships found between income and the rate of consumption of various dairy products indicate the dependence of the prosperity of the dairy industry upon an increase in the incomes of the low- and middle-class groups in the cities.